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THE AVOCADO IN CALIFORNIA

PART I.—CULTURE, PRODUCTION, AND MARKETING

BY

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BY

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AVOCADO CULTURE IN CALIFORNIA

BY

IRA J. CONDIT

The avocado is a fruit native to the tropical and semi-tropical regions of North and South America, where it is used as a common and much-prized article of food. From its native home it has spread to practically all tropical countries. Since its introduction into California, at Santa Barbara in 1870, many trees grown from seed obtained from Mexico, Guatemala, Hawaii, and from local trees, have been planted, principally in the southern part of the state. The abundant fruiting of many of these seedling trees and the high prices received for the fruit in local markets account for the rather sudden interest in avocado planting. Many orchards ranging in size from a fraction of an acre to five or ten acres have been planted in various sections of the state and much larger plantings are contemplated.

The avocado tree is an evergreen with fairly large, leathery leaves and under favorable circumstances reaches a height of sixty or even eighty feet. It belongs to the Laurel family, the leaves having the spicy odor and taste common to plants of this family. This odor is usually much more noticeable in the leaves of the hardy thin-skinned Mexican varieties than in the more tropical hard-shelled varieties. The fruit varies in form from round to pear-shaped with a short or elongated neck, and in weight from a few ounces to four or five pounds. It contains a single large seed which is surrounded by yellowish, buttery flesh. The fleshy edible part is rich in protein and oil, the percentage of the latter varying from 9.8 to 29.10 per cent. (See p. 400.) The flavor and quality are also extremely variable; undoubtedly some varieties which are excellent so far as early bearing and productiveness of tree and size and shape of fruit are concerned will have to take lower rank on account of poor quality.

The flesh of the avocado is essentially a vegetable butter, a substantial food. The fruit contains an extremely small amount of acid and sugar and a very large amount of oil, but on account of its scarcity has been used in the United States almost entirely as a salad, requiring only a little salt and lemon juice or vinegar to make it

Fig. 1.—The Taft avocado averages over one pound in weight. The tree blossoms in the spring, the fruit maturing in about fifteen months, although it may be held on the tree three or four months longer.

acceptable to most palates. In fact, from the earliest records up to the present time the flesh of the avocado has been described as a natural mayonnaise and is often eaten as taken from the fruit, without additional preparation. The natives of Mexico spread the pulp on their black bread in place of butter.

The rapid growth of young trees, the early fruiting and prolificness of many good varieties, the high food value, and the popular demand for the fruit have caused many fruit-growers to become interested in the commercial possibilities of the avocado in those sections of the state where climatic conditions are most favorable. It is hoped that the information herein set forth may prevent some of the mistakes which are likely to occur in the development of any new fruit industry.

CLIMATIC REQUIREMENTS

Many types of avocados have been introduced into California, some from the tropical lowlands of Hawaii, Mexico, and Central America; others from the highlands of Mexico, where the winter frosts, although quite severe, do not entirely prevent the production of abundant crops. In general, the thin-skinned Mexican varieties have proved hardier than the hard-shelled Guatemalan types. Hard-shelled varieties from elevations of 5000 to 6000 feet in Mexico, Columbia, and Chili have already been introduced and it is believed that they will prove hardy in the citrus-growing districts of California. It is advisable, however, to test out the fruiting qualities of these new varieties under our climatic conditions before planting them extensively. Some types will be uninjured by ten degrees of frost, provided the season's growth is properly hardened by reducing the amount of water during the latter part of the season; other types are injured by three or four degrees of frost, while the strictly tropical varieties will not withstand even cold, frostless nights, the leaves and tender branches turning brown and dying back under such conditions. Mature trees themselves are not so subject to damage on frosty nights as the blossoms and young fruit of winter-flowering varieties. Varieties of the Guatemalan type usually bloom so late in the spring that there is very little danger of frost. The partly matured fruit of such varieties usually passes through the winter without injury except in unusually severe seasons, such as that of 1912–13, when the freezing of the stems caused the fruits to drop. It is advisable to protect young trees from frost during the first two or three seasons with cornstalks, palm leaves, burlap, or by the use of orchard heaters. The

broad leaves of avocado trees are not resistant to excessive dry heat as are those of the loquat and olive and are often seriously injured by hot, dry winds. The trunks of young trees should be shaded by some form of tree protector or by loosely wrapped newspapers, as many young trees have been ruined by direct exposure to the mid-day sun. The branches are rather brittle and young trees should be protected from violent winds. Although bearing trees have sufficient

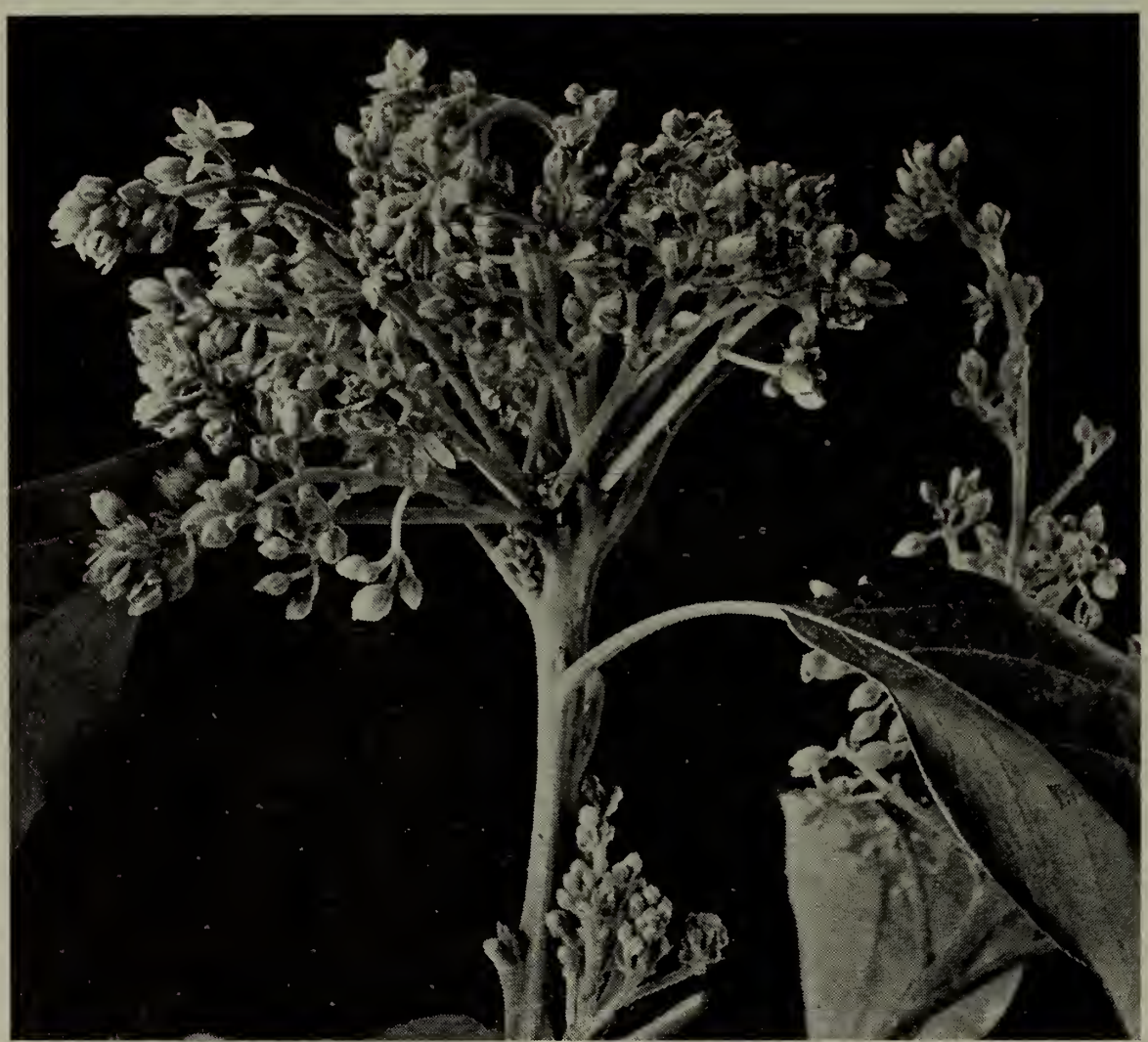

Fig. 2.—Avocado flowers are perfect and usually set fruit in abundance. Heavy rains at the time of blossoming prevent pollination; severe frosts may destroy the blossoms entirely.

elasticity to enable the branches to carry heavy loads of fruit without breaking, it is advisable to select, for planting, locations where the wind is not too severe.

The southern coast districts of California appear to be well adapted to avocados since many large trees of various types have been fruiting successfully there for several years. Other parts of the state from Riverside to Butte County are now being tested by planting, not only seedlings but, also, budded trees of numerous varieties, and some seem

to be withstanding successfully both the winter's cold and the summer's heat. It is impossible at present to state definitely what the geographical limits of commercial avocado culture will be. It is not unlikely, however, that some varieties of avocados can be grown successfully wherever the orange, lemon, and pomelo thrive. Those who contemplate planting avocados in untried localities should proceed cautiously and not plant any variety extensively unless they are willing to assume the risks of the pioneer.

PROPAGATION AND CULTURE

Avocados are easly grown from seed, but the resulting plants are exceedingly variable in growth, age of bearing, and productiveness. Some trees never blossom, others blossom but set very little if any fruit, while a few produce very good fruit. Budded trees are reproductions of the tree from which the bud was taken and only budded trees of known varieties should be planted for commercial purposes. Seedlings grown from the small, thin-skinned Mexican fruits are preferred as stock for budding on account of their greater hardiness, but there are very little if any data at present to show the superiority of one stock over another so far as the resulting tree is concerned.

Producing Seedlings.—Seeds are commonly planted with the pointed end up, in four or five-inch pots containing sandy soil about one-fourth of the seed being left exposed. Germination often takes place in one month if bottom heat is used; in a lath house or in the open three or four months are required for germination. In some nurseries the seeds are germinated in seed beds and then placed for a short time in four-inch pots. Seedlings should not be left in small pots for any great length of time. If the root system once becomes pot-bound or establishes a circular growth of roots, it is very difficult to get young trees to thrive when planted out. When the seedlings are from six to eight inches high they are transplanted to nursery rows, being placed about sixteen inches apart in the row. The seedlings should be ready to bud by the following October or November, the buds remaining dormant until early spring.

Methods of budding.—The method of budding is very similiar to that used with citrus trees, a large shield bud being preferred. The degree of success in budding depends upon the condition of the stock, the selection of good buds, the skill of the operator, and the subsequent treatment of the plants. The following method of budding has been most successful. Select young wood of the current season's growth,

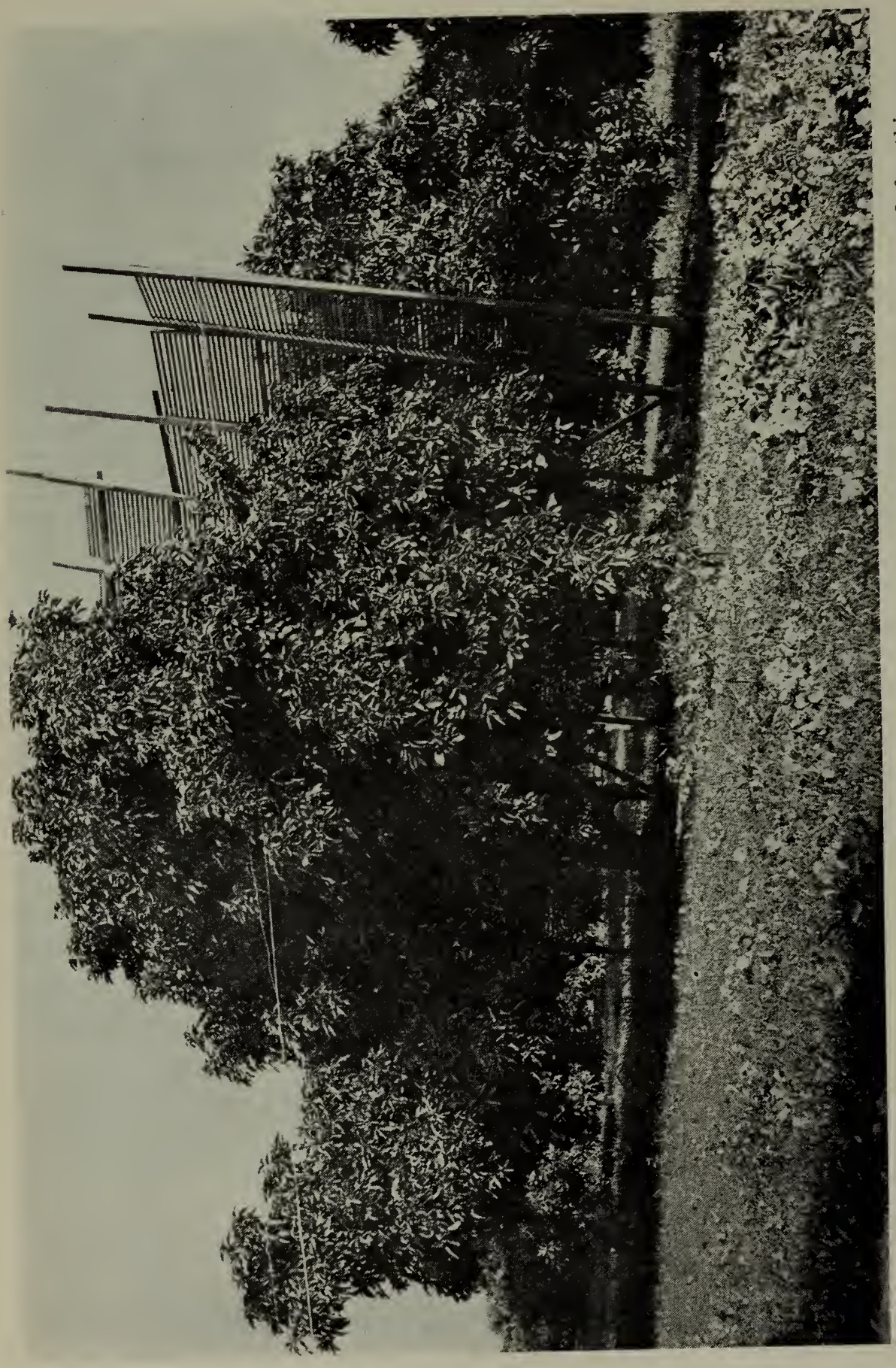

Fig. 3.—Avocado trees need protection from high winds, lath shelters being commonly used for this purpose. The original tree of the Taft variety shows a more spreading habit of growth than is the case with many seedling trees of the same age.

cut the bud from one to one and one-half inches long, insert it into a T-shaped incision in the bark of the stock whenever the sap is flowing freely, and bind firmly with waxed tape. At the end of two weeks, examine the work and loosen the tape if it is beginning to bind the stock too tightly. Remove the tape entirely at the end of six weeks, at which time the bud should be firmly united with the stock. The bud is usually forced into growth by gradually cutting back, first, the side branches and later, the main stem of the stock, the stub of which should not be cut back to the bud until the lower leaves of the new shoot have become quite mature. Budded trees are allowed to grow for one year in the nursery row before transplanting.

Transplanting from Nursery.—The transplanting of balled trees from nursery rows is best done from January to March, and it is advisable to hold the trees in a lath house for a couple of weeks before planting. As a result of early planting, the trees will become established and the new growth become more or less mature before the heat of summer. Trees in orchard form should be spaced at least twenty-five feet apart. Young trees require little pruning except an occasional pinching back of vigorous shoots to induce a more symmetrical growth.

General Care of Trees.—Budded trees are usually more or less dwarfed and come into bearing early as a rule, although there is considerable variation among the different varieties in this respect. Budded trees should begin to bear profitably the fourth or fifth year in the orchard; some will begin fruiting even in the nursery row. The avocado tree should be planted in soil which has considerable depth, contains an abundance of plant-food, and is well drained. For ease of cultivation and irrigation, a sandy loam is preferable, but the tree grows just as well, if not better, on a rather heavy soil with plenty of humus. Very little if any fertilizer should be necessary until the trees come into bearing; a mulch of straw or coarse manure may be placed around the tree to conserve moisture, but care should be taken to keep the latter from direct contact with the trunk or injury from heating will occur. Water in abundance should be provided during the first season or two in order to keep the tree in active growth, but the amount should be reduced in the late fall, as previously stated, to induce the tree to stop growth and mature its new wood in preparation for winter. However, when very hot days occur in late summer or fall, water should always be given, if only a bucketful at a time to each young tree. Avocados require about the same amount of irrigation water as lemon trees.

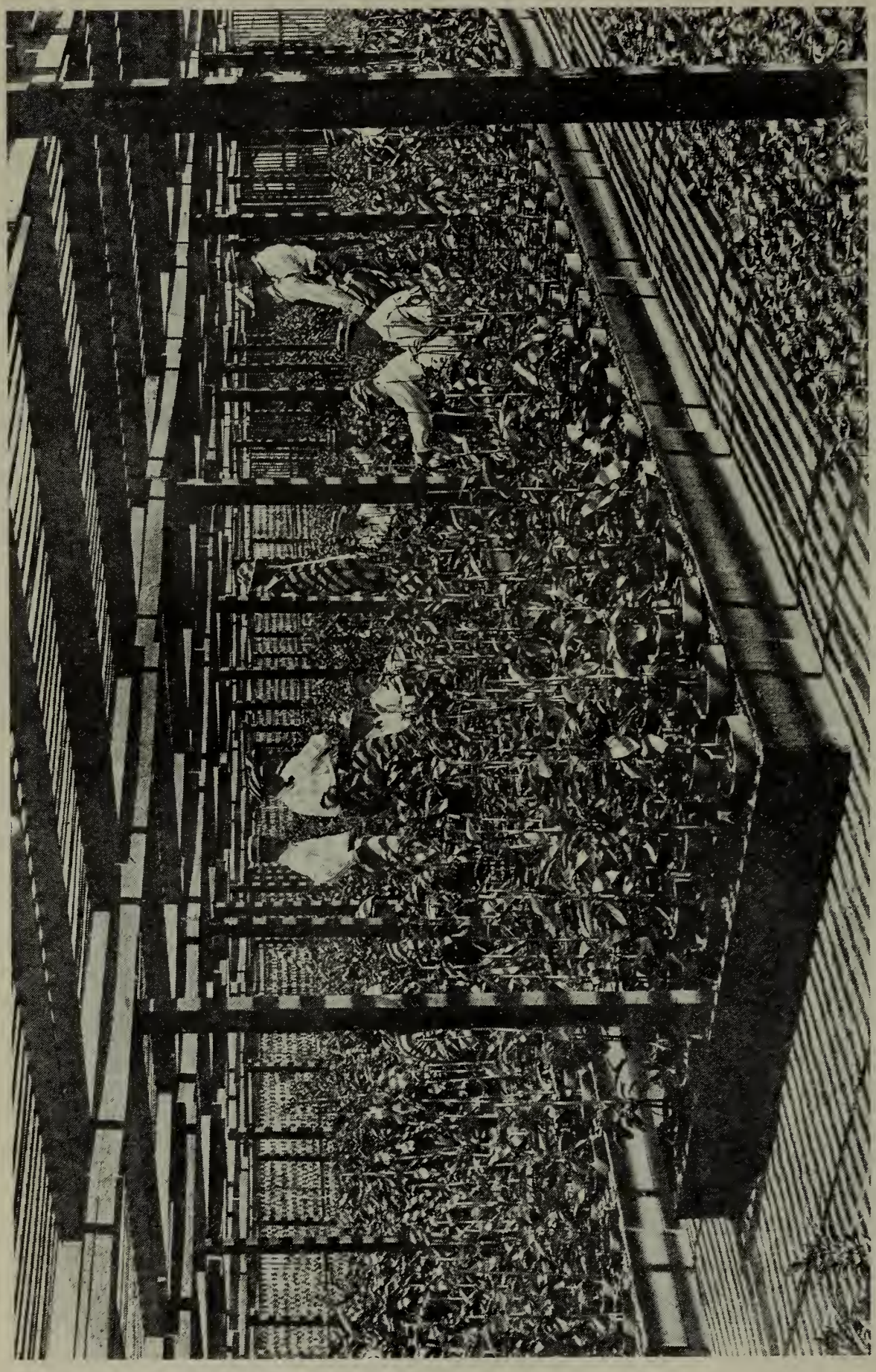

Fig. 4.—The West India Gardens at Altadena have grown thousands of seedlings in pots under a lath house, but are now growing the bulk of their nursery stock in the open ground.

It is often desirable to top-work large seedlings or trees of one variety to another. This has been successfully accomplished by budding into new wood forced out for the purpose. The trees are cut back severely in the spring and the ends of the stubs are covered with heavy grafting wax or asphaltum paint to prevent decay. Only three or four of the new shoots should be left, and when these have reached a diameter of three-fourths of an inch they may be budded in the same manner as seedlings. The shoots from the buds grow rapidly and often begin to bear in two years.

PRODUCTION AND MARKETING

Avocado trees are in many cases remarkably prolific. Individual trees of the thin-skinned Mexican type in Los Angeles County have produced annually as many as 5000 small fruits with thin flesh and rather large seed. Such fruits are at present valuable for their seeds, on account of the scarcity of root stocks for budding. Many trees fifteen to twenty years old, both of the thin-skinned and hard-shelled types, have produced over 1000 fruits each in one season, while a few have produced from 2000 to 2500. It is doubtful if such large yields can be obtained from orchard trees season after season, since budded trees do not usually grow as large as seedlings. A yearly average of 500 marketable fruits per tree from ten to fifteen-year-old trees planted twenty-five feet apart may be considered a fair yield. Some varieties with small-sized fruit may produce more.

The thin-skinned avocados bloom in the late winter and early spring, the fruit maturing from August to December. The hard-shelled varieties thus far grown in California bloom early in spring and usually require more than a year to mature. The fruit should be picked when mature and ripened off the tree, the length of time the fruit will keep varying with the different varieties but depending largely upon the degree of ripeness when it is picked. If the fruit is kept too long, on retail fruit stands, for example, the oil in the flesh becomes rancid, rendering the fruit unfit for consumption. Experiments with cold storage for avocados show that the fruit can be held at a temperature ranging from 32° to 35° F. for a period of at least two months.

Avocados grown in California and shipped to Eastern or even to Middle Western markets will have to compete more or less with fruit from Florida and the West Indies, especially in the fall of the year. Whether this competition can be met with avocados as successfully as it is being met with citrus fruits remains to be seen. Even should it be found impracticable to pack and ship thin-skinned fruits

to Eastern markets and have them arrive in condition to sell in competition with hard-shelled fruits from Florida, such fruit should be in demand in the local markets for some years to come.

Estimates of profits to be derived from an avocado orchard should not be based on the performances of large seedling trees, nor on the prices received for fruit in the past. The present price of from $4 to $8 a dozen may not long be maintained when orchards now planted come into bearing and the fruit becomes more common, although high prices will probably be received for some years to come. In the

Fig. 5.—The Solano is a large, green-fruited avocado having a small seed and a large amount of flesh of fair quality. Size of fruit, 5¾ by 3⅞ inches.

United States the avocado is a comparatively new and little known fruit and experience in San Francisco has shown that it is easy to overstock that market.

INSECTS AND DISEASES

There are no serious pests of the avocado in California, although in other countries the tree and fruit are subject to the attacks of several injurious insects and fungi. Shipments of avocado fruit into this state from Hawaii are prohibited on account of the danger of introducing the Mediterranean fruit fly in the fruit. Shipments from Mexico are no longer made, since the seeds of Mexican avocados are

liable to be infested with the larva of a weevil which might become established here. Occasional shipments of one to two hundred crates are being made into California from the Island of Tahiti, where the fruit fly has not so far been found, and from Florida, where there are no known pests liable to be introduced with the fruit.

The fruits of some varieties of thin-skinned avocados in California have a tendency to ripen and turn dark at the apex first if left on the tree too long. In the past this has been considered to be due to

Fig. 6.—The Chappelow is a good example of the purplish-black, thin-skinned type of avocado. The quality and flavor of such fruits is usually very good. This variety analyzed 29.10 per cent of fat in the fresh fruit. Size of fruit, 3½ to 4¼ inches long.

a fungus disease, and while its exact nature is uncertain it has been found that this softening can be largely avoided by picking the fruit at the proper stage of maturity.

VARIETIES

Probably the most important and at the same time the most perplexing question confronting avocado planters today is that of varieties. At least twenty-five varieties of California origin have already been described and doubtless as many more are being propa-

gated and heralded by enthusiastic owners or nurserymen. In addition, a score or more varieties from other countries have been introduced and are being propagated by the thousand in some cases. The unbiased opinion of some persons who have traveled in Mexico and other countries and eaten avocados from native trees is that the commercial avocado variety of the future has not yet appeared; others claim that some California varieties have no superior anywhere. New kinds should be thoroughly tested in order to show their adaptability to our climatic conditions before being planted extensively. California seedlings which have been fruiting for several years have a decided advantage, as it is already known what they will do under certain California conditions.

The requirements of a good commercial variety may be briefly outlined as follows:

1. The bud of such a variety should be able to grow into a vigorous, upright, orchard tree.
2. It should be sufficiently hardy to withstand ordinary frosts.
3. It should be precocious, prolific, and a regular bearer.
4. It should blossom late enough for the flowers to escape heavy spring frosts.
5. The fruit should be of good flavor and quality.
6. The size and shape of the fruit should be uniform and not too large, approaching oval or round, rather than "bottle-necked," and averaging about one pound in weight.
7. The fruit should be well adapted to shipping.
8. The seed should be small and tight in the cavity.

Many of the thin-skinned Mexican avocados are superior so far as flavor is concerned and are excellent fruits for home use and local market. Seedlings and budded trees of such varieties as the Harman, Northrup, Chappelow, and Carton grow vigorously and develop into shapely orchard trees. Growers who are undecided as to the variety to set out are advised to plant a hardy type, such as one of the above, and, if desired, bud the trees over a few years hence when there are more reliable data regarding commercial varieties.

Pomological descriptions of varieties are reserved for a later publication. The notes presented herewith are intended merely to assist the grower in selecting the variety best suited to his needs and location.

Thin-Skinned Varieties:

Harman.—Purplish green, averaging about one-half pound in weight, with a tendency to crack around the apex when mature; seed usually loose in the cavity; tree hardy, prolific; one of the best of its type.

Northrup.—Almost black, of medium size and good quality; has two crops a year, a large fall crop and a small spring crop.

Carton.—Very dark purple, pear-shaped, averaging about 12 ounces in weight; surface smooth, not glossy; quality good.

Chappelow.—Black with a glossy surface, bottle-necked; tree only moderately productive; blossoms early and the flowers are sometimes injured by frost.

Ganter.—Green, medium sized, of good quality; turns black at the apex and decays rather quickly when mature; tree hardy, vigorous, and very productive.

Fig. 7.—The seed of an avocado should be small and tight in the cavity. The Sharpless, shown here, has an exceptionally large proportion of edible matter and a relatively small seed. Size of fruit, 6¼ by 3½ inches.

White.—Black, elongated, of medium size and fair quality; surface smooth and glossy; has no points to recommend it over other varieties.

The Fowler and Blake are green-fruited varieties, pear-shaped and of fairly good quality, but have no strong characteristics in their favor.

The Taft Hardy, a variety put on the market last season, should not be confused with the original Taft, a larger, hard-shelled fruit.

Hard-Shelled Varieties:

Taft.—Pear-shaped, of over one pound weight, and of extra good quality; budded trees have not shown a tendency to bear early; the original tree bears regularly and is becoming more productive as it grows older; tree ornamental; one of the hardiest of its type; a leading commercial variety.

Challenge.—Very prolific, bearing round fruits averaging about one pound in weight; a very promising commercial variety.

Lyon.—Large, pear-shaped, of good quality; tree prolific and precocious.

Meserve.—Dark green, round, of good size and quality; a promising commercial variety.

Dickey.—Green, pear-shaped, of good quality; difficult of propagation; buds start to grow but seldom live more than a few months.

Blakeman.—Green, pear-shaped, medium to large, of about one pound weight, of extra good quality; a promising commercial variety.

Walker.—Pear-shaped, medium in size, only fair in quality, its chief recommendations being precocity and productiveness.

Royal.—Oval, medium sized, weighing one pound or more, of fair quality; tree vigorous, only moderately prolific.

Miller.—Oval, of medium size and fairly good quality; tree only moderately prolific.

Murrietta.—A good round-fruited variety which matures in the spring; a desirable type and of extra good quality; almost impossible to get buds to develop into good orchard trees.

Solano.—Large, weighs from one to two pounds; quality good; tree productive considering the size of the fruit.

Colorado (commonly known as Purple Murrietta).—Purplish-black, rather large; weight about one pound; flavor and quality good.

El Presidente.—Oblong, pear-shaped, olive-green, of about one pound weight and of fairly good quality.

Dickinson.—Medium sized, dark purple, with very rough surface; tree vigorous but rather tender.

Sharpless.—Large, pear-shaped, averaging over one pound in weight; seed very small in proportion to amount of flesh; a promising variety.

The Rhoad, Senor, Champion, Rita, Ultimate, and Beauty are varieties developed in Orange County and are more or less promising, but have not been largely propagated.

The Wagner bears round fruit of medium size. The tree shows promise of being quite prolific.

The Ideal, Two-pound Green, San Sebastian, Queretaro, Redondo, California Trapp, Montezuma, Atlixco, Sinaloa, Modesto, Furnival No. 1, Popocatepetl, Val de Flor, Itzia, and Johnson No. 5 and No. 6 have been introduced from the highlands of Mexico during the last few years and are now under trial.

The Chili was introduced from the highlands of Chili. Other introductions have been made from Guatemala and Colombia and are now being propagated. Among these numerous introductions there are undoubtedly some very hardy and superior varieties, but until they have shown their adaptation to our conditions extensive plantings are not advisable.

THE NUTRITIVE VALUE OF THE AVOCADO

BY

M. E. JAFFA

The investigation here reported includes the analyses of 28 different varieties of the avocado. These data emphasize the value of this fruit as an excellent source of easily digested vegetable fat.

Composition of Fruits.—A reference to the composition of fresh fruits in general shows that the amount of water is *large* and that the percentages of the nutrients indicate that the main food value is derived from carbohydrates. In nearly all cases the sugars predominate, starch being present in small amounts only.

The protein content of fruits is low, varying from .2 per cent as an average for the loquat to 2.5 per cent for the olive. The stone-fruits contain, on the average, less than 1 per cent.

The figures for the mineral matter or ash in fresh fruits are, in general, much lower than the corresponding data for meats or grain. The average for meat is about 1 per cent, while for fruit it is much less.

It must not be forgotten, however, that while the *amount* of ash is small, the percentage of potassium, so essential to the animal economy, is high. This is a very valuable base-forming element which is necessary in the maintenance of the normal neutrality of the blood and tissues. The importance of the mineral matter in nutrition and the necessity of carefully selecting the dietary so as to secure a proper balance between the base-forming and acid-forming elements is becoming more and more apparent.

Fat is present in very small proportions in fresh fruits. This constituent is generally reported as "Ether Extract," which often contains other materials than true fat or oils, such as coloring matter, wax found in skin, etc. The figure, therefore, reported for fat in most fruits is seldom a true indication of the content of this nutrient.

COMPOSITION OF THE AVOCADO

A survey of the data presented shows the avocado to differ widely in many respects from the average of fresh fruits and proves it worthy of special consideration. It might almost be said to be in a class by itself.

TABLE 1.—SHOWING THE COMPOSITION OF AVOCADO

No. and Variety	Locality and Grower	Date	Wt. of fruit, gms.	Refuse				Edible portion		Analysis of edible portion				
				Seed, gms.	Skin, gms.	Total Gms.	Total Per ct.	Gms.	Per ct.	Water, per ct.	Protein, per ct.	Fat, per ct.	Carbohydrates, per ct.	Ash, per ct.
		1913												
1. Ganter	Whittier A. N. Rideout	1–3	205	24.0	10.0	34.0	16.6	171.0	83.4	63.86	2.25	25.60	6.58	1.71
2. Harman	Sherman	10–10	235	55.0	54.0	109.0	46.4	126.0	53.6	71.58	2.50	19.33	5.32	1.27
		1914												
3. Miller	Hollywood Jacob Miller	7–6	184	30.0	36.0	66.0	35.8	118.0	64.2	66.60	3.70	23.70	4.51	1.49
4. Walker	Sherman Ed. Harman	8–15	173.5	43.7	20.7	64.4	37.1	109.1	62.9	68.66	3.15	18.71	7.55	1.93
5. Sharpless	Santa Ana H. B. Sharpless	8–17	471	60.0	40.0	100.0	21.2	371	78.8	76.73	2.15	15.73	3.69	1.70
6. Chappelow	Monrovia Wm. Chappelow	9–21	180.5	22.0	19.5	41.5	23.0	139.0	77.0	60.94	1.40	29.10	6.85	1.71
7. Blake	Pasadena D. W. Coolidge	10–3	150	31.0	18.0	49.0	32.6	101.0	67.4	65.76	1.88	25.50	5.52	1.34
8. Chappelow	Monrovia Wm. Chappelow	10–15	142 191	32.7 33.8	21.0 26.0	53.7 59.8	37.8 31.2	88.3 131.2	62.2 68.7	*72.35	2.16	17.68	6.47	1.34
9. Carton	San Fernando P. F. Carton	10–15	189	36.5	31.0	67.5	35.7	121.5	64.3	63.53	1.34	.....	.....	1.30
10. Carton	San Fernando P. F. Carton	10–15	169	39.5	30.0	69.5	41.2	99.5	58.8	70.43	2.60	19.50	6.29	1.18
11. Unnamed	.....	10–21	217	31.8	21.0	52.8	24.4	164.2	75.6	65.50	2.60	23.10	7.40	1.40
12. Topa Topa	E. S. Thacher Nordhoff	10–21	123	21.0	13.0	34.0	27.7	89.0	72.3	75.00	2.30	15.48	6.14	1.08
13. Mattern	.....	10–22	92	28.0	12.6	40.6	44.1	51.4	55.9	61.55	2.20	25.70	8.94	1.61
14. Northrup	F. O. Popenoe	10–23	218	45.0	23.4	68.4	31.4	149.6	68.6	61.08	2.50	27.60	7.92	0.90
15. Seedling No. 1	Carpinteria O. M. Cadwell	10–22	148	37.2	12.1	49.3	33.3	98.7	66.7	62.65	1.70	27.89	6.83	0.93
16. Seedling No. 2	Carpinteria O. M. Cadwell	10–22	100	31.0	10.0	41.0	41.0	59.0	59.0	73.09	1.30	15.30	9.41	0.90
17. Seedling No. 3	Carpinteria O. M. Cadwell	10–22	122	23.8	12.4	36.2	29.7	85.8	70.3	65.10	1.60	23.40	8.74	1.16

* Analysis-average of two samples.

TABLE 1.—SHOWING THE COMPOSITION OF AVOCADO—(*Concluded*)

No. and Variety	Locality and Grower	Date 1914	Wt. of fruit, gms.	Refuse: Seed, gms.	Refuse: Skin, gms.	Refuse: Total Gms.	Refuse: Total Per ct.	Edible portion Gms.	Edible portion Per ct.	Analysis of edible portion: Water, per ct.	Protein, per ct.	Fat, per ct.	Carbohydrates, per ct.	Ash, per ct.
18. Seedling No. 4	Carpinteria O. M. Cadwell	10–22	93	30.0	9.5	39.5	42.5	53.5	57.5	68.00	1.50	20.75	8.44	1.31
19. Seedling No. 5	Carpinteria O. M. Cadwell	10–22	114	32.0	12.5	44.5	39.0	69.5	61.0	68.07	1.50	13.00	16.17	1.26
20. Seedling No. 6	Carpinteria O. M. Cadwell	10–22	94.5	25.0	29.0	54.0	57.1	40.5	42.9	67.58	1.60	17.20	12.36	1.26
21. Harman	Sherman	10–26	243	57.0	32.0	89.0	36.6	154.0	63.4	*74.70	1.60	18.30	4.60	0.80
	Ed. Harman		283.5	56.0	37.0	93.0	32.8	190.5	67.2					
22. White	Santa Barbara	10–26	171	42.0	19.8	61.8	36.1	109.2	63.9	*77.06	1.74	14.64	5.49	1.07
	E. L. White		154.5	35.0	18.3	53.3	34.4	101.2	65.6					
23. Fowler	Pasadena	11–2	135	34.5	14.0	48.5	35.9	86.5	64.1	*70.33	1.60	21.20	5.61	1.26
	Mrs. Fowler		129	32.5	13.6	46.1	35.7	82.9	64.3					
24. Northrup	Pasadena	11–4	120	36.4	12.4	48.8	40.7	71.2	59.3	*61.20	3.40	.....	.....	.....
	W. India Gardens		117	35.7	12.3	48.0	41.0	69.0	59.0					
25. Cardinal	Larkin, Dade Co., Florida Dorn Bros.	11–4	587	72.1	39.2	111.3	19.0	475.7	81.0	79.66	2.56	10.70	6.48	0.60
26. Northrup	Santa Ana	11–6	198	48.0	17.0	65.0	32.8	133.0	67.2	*66.31	2.36	23.00	7.12	1.21
	E. Bartley		127	32.0	14.5	46.5	36.6	80.5	63.4					
27. Trapp	Larkin, Dade Co., Florida Dorn Bros.		637.8	129.5	52.6	182.1	28.5	455.7	71.5	78.66	1.61	9.80	9.08	0.85
28. Azusa	Azusa Volney Metcalf		198	36.1	20.0	56.1	28.3	141.9	71.7	67.05	1.94	21.06	8.59	1.36

No. and Variety	No. of analysis	Wt. of fruit, gms.	Refuse: Seed, gms.	Refuse: Skin, gms.	Refuse: Total Gms.	Refuse: Total Per ct.	Edible portion Gms.	Edible portion Per ct.	Analysis of edible portion: Water, per ct.	Protein, per ct.	Fat, per ct.	Carbohydrates, per ct.	Ash, per ct.
29. Maximum	28	637.8	129.5	54.0	182.1	57.1	475.7	83.4	79.66	3.70	29.1	16.17	1.93
30. Minimum	28	92.0	21.0	10.0	34.0	16.6	40.5	42.9	61.08	1.30	9.8	3.69	0.60
31. Average	28	197.4	40.0	22.5	62.5	34.3	135.8	65.7	69.16	2.08	20.1	7.39	1.26

* Analysis-average of two samples.

The tables are replete with interesting points, all very favorable to the avocado. The total dry matter in the edible portion is, in nearly every instance, greater than that noted for any fresh fruits. The average for the avocado is 30.84 per cent. The nearest approach to this figure is found in the banana, with about 25 per cent dry matter. It must be remembered, however, that while there may not be so much difference in the total solids of the two fruits in question, there is a great difference in the nature of the nutrients. Sugar and starch predominate in the banana as against fat in the avocado.

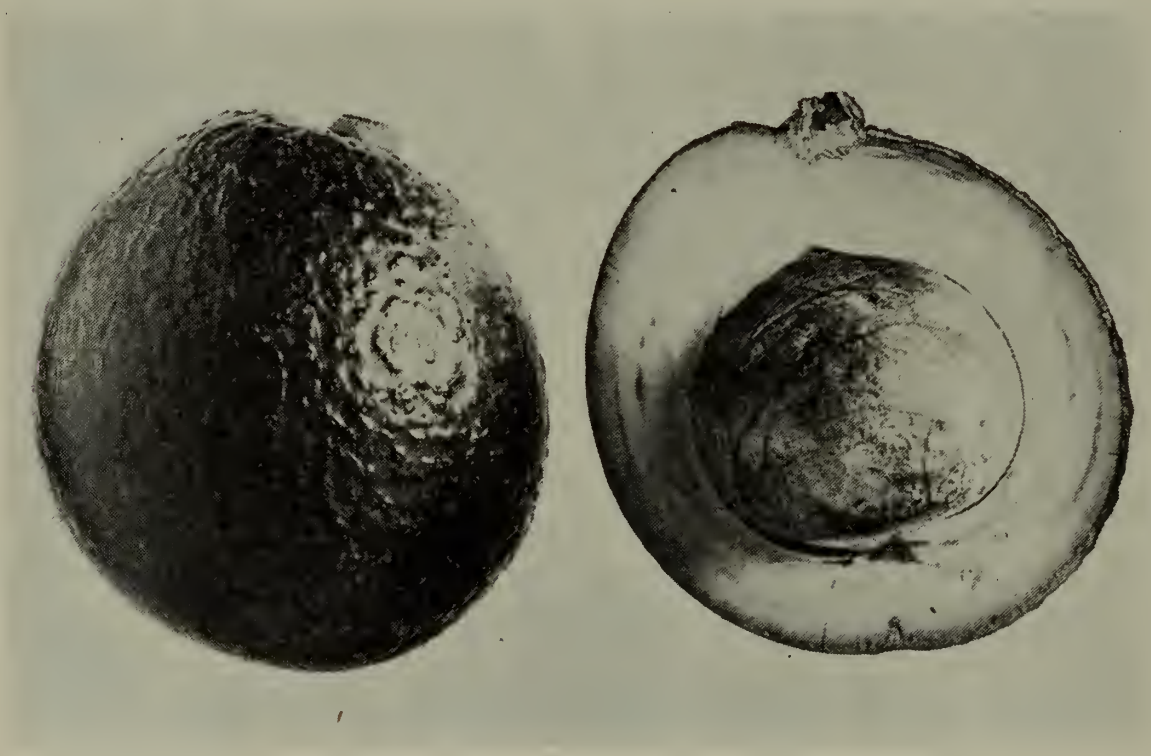

Fig. 8.—The Challenge has a thick, hard shell; rough, shiny surface, rather large seed, and fair quality of flesh. The original tree is productive, about 2500 fruits having been picked in 1915. Size of fruit, 3½ by 3½ inches.

It has been stated that the protein per cent in all fruits is low averaging less than 1 per cent. It will be seen from the table that the *minimum* figure for protein, 1.30 per cent, is nearly equal to the maximum indicated for fresh fruit, 1.5 per cent, noted for figs and currants. The maximum, 3.7 per cent, corresponds somewhat closely to the protein content of some dried fruits. In three varieties the protein is present in excess of 3 per cent; in ten varieties considerably above 2 per cent; while the average for the 28 varieties is 2.08 per cent. It, therefore, may be said that so far as protein in fresh fruits is concerned, the avocado stands far in the lead.

The carbohydrate content of the avocado, with the exception of seedlings Nos. 5 and 6 submitted by O. M. Cadwell of Carpinteria, is low as compared with this constituent in fresh fruit. The average for the 28 varieties is 7.39 per cent, and this would have been appreci-

ably lowered if the data for the two seedlings above mentioned had been omitted from the average.

The figures quoted in the table for carbohydrate include crude fiber, which was not determined in every case. Analyses have shown, however, that this ingredient is present to the extent of about 1.75 per cent, comparing favorably with the content of fiber in the other fresh fruits.

It is of decided interest to note that the mineral matter in the avocado is much greater than that found in any fresh fruit. Just how much importance can be attached to this fact can better be stated

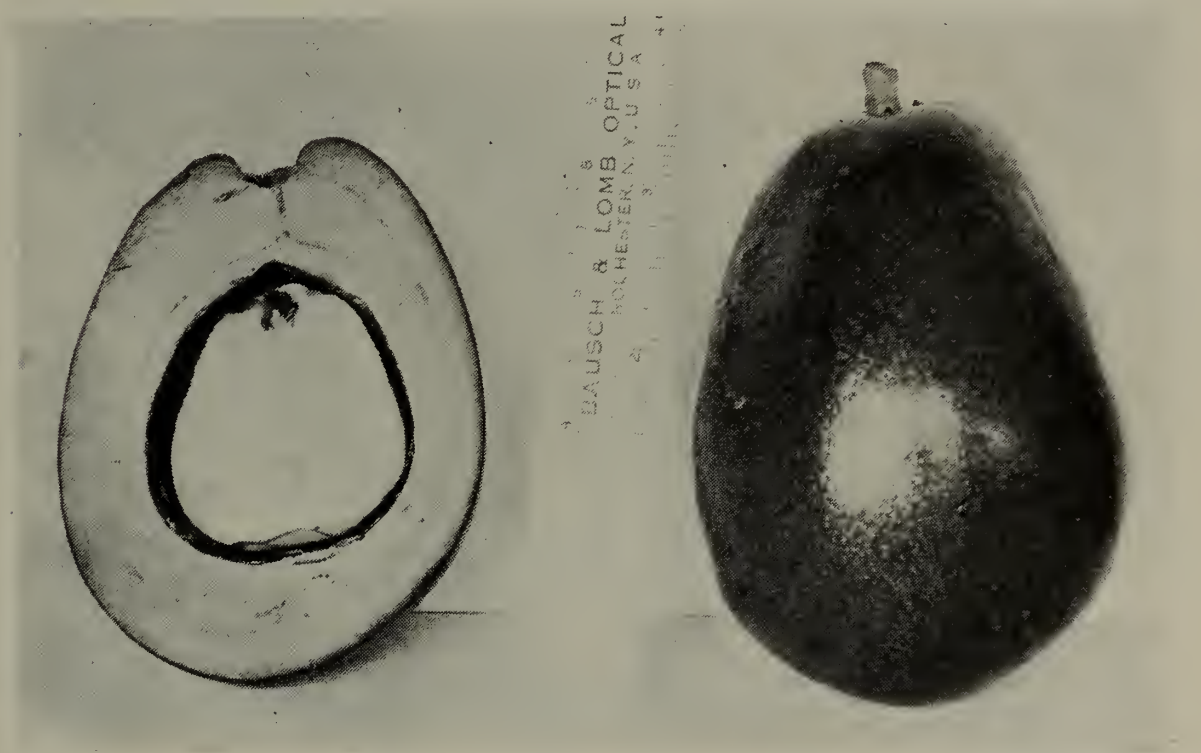

Fig. 9.—The Ganter is a green-fruited variety having a thin skin and good quality of flesh. The rattling of the loose seed in the cavity with the consequent bruising of the flesh is a slight disadvantage in marketing.

after the conclusion of the detailed analysis of the ash, which will indicate the per cent of potassium, calcium, phosphoric acid, iron, etc. The results of the ash analyses will be published as a supplementary report.

The minimum per cent of ash, .60, noted for the variety, Cardinal, from Florida, exceeds the per cent of ash determined for apples, apricots, grapes, blackberries, oranges, pears, and plums, and fully equals the corresponding figure for cherries, figs, melons, and prunes.

The minimum per cent of ash noted for a variety grown in California is 0.80 per cent, exceeding that found in any of the fresh fruits. As seen from the table, the average for the 28 varieties is 1.26 per cent, only slightly below the ash percentage in dates.

The foregoing discussion clearly indicates that so far as protein and ash in fresh fruits are concerned, the avocado stands at the head of the list, and, with reference to the carbohydrates, contains on an average fully 50 per cent of that found in many fresh fruits. These facts alone would warrant due consideration being given to the value of the avocado as a fresh fruit.

The chief value of the avocado as food, however, is due to its high content of fat. This varies, as shown by the analyses, from a minimum of 9.8 per cent to a maximum of 29.1 per cent, with an average of 20.1 per cent.

Reviewing the analytical data, it will be seen that ten varieties show more than 23 per cent fat and seven other varieties an excess of 18 per cent.

The only fruit comparable with the avocado in this respect is the olive. In this connection, it is of interest to compare, as shown in the following table, the fat percentages of the edible portion of those ten varieties of the avocado containing 23 per cent, or upwards, of fat with ten varieties of the olive.

TABLE 2.—SHOWING PERCENTAGE OF FAT OR OIL IN THE AVOCADO AND OLIVE

Avocado				Olive	
Original material water free Edible portion				Original material Edible portion	
No. and Variety	Water, per ct.	Fat, per ct.	Fat, per ct.	Variety	Oil, per ct.
8. Chappelow	60.94	29.10	78.01	Corregiolo	27.68
15. Seedling No. 1	62.65	27.89	74.67	Nigerina	26.16
14. Northrup	61.08	27.60	70.88	Nevadillo Blanco	22.92
13. Mattern	61.55	25.70	66.84	Mission	22.51
1. Ganter	63.86	25.60	70.84	Rubra	22.01
7. Blake	67.40	25.50	74.48	Pendulina	21.36
3. Miller	66.60	23.70	70.96	Redding Picholine	20.83
17. Seedling No. 3	65.10	23.40	67.05	Macrocarpa	20.41
11. Unnamed	65.50	23.10	66.96	Manzanillo	19.73
26. Northrup	66.31	23.00	68.27	Columbella	19.54

The figures in Table 2 indicate that the avocado ranks higher in fat or oil than the average or commonly used olive. The latter fruit also has the disadvantage of requiring special treatment before it is ready for consumption and should really rank as a processed fruit rather than a fresh one. The data in the table show that when considering the dry matter only No. 8, Chappelow, shows the highest percentage of fat. In the original conditions the Northrup and an unnamed fruit differ by nearly 4 per cent, which difference is practically eliminated when comparison is made on a water-free basis, which is the only true way to compare the nutritive value of fruits.

CALORIC VALUE

While it is true that the real value of any food is not always represented by the heat units or calories, at the same time the *total* food value is so indicated. This difference between the real value and total food value is not always properly understood. For instance, the energy value of a pound of sugar is 1820 calories, while the corresponding value for lean meat is less than 1000 calories. Yet we would hardly say that the real value of a pound of sugar was 1.8 times that of a pound of lean meat, if the question of growth were under consideration. When, however, the matter of energy is being discussed the case is entirely different, and the value of a food as a source of energy varies directly with its caloric value.

The energy values of the edible portion of the commonly used fresh fruits are low, ranging from a minimum of 175 calories to a possible maximum of 400 calories per pound.

An inspection of Table 3 shows that the avocado has a far higher value in this respect; the average of twenty-six varieties being 984 calories per pound, or more than twice the maximum noted for other fruits. The minimum figure, 597, is also in excess of this maximum. The maximum, 1325 calories per pound, approaches that noted for some varieties of dried fruits. It corresponds to about 75 per cent of the fuel value of the cereals and is not far from twice that noted for average lean meat.

TABLE 3.—SHOWING THE ENERGY VALUE OF THE AVOCADO

No. and Variety	Energy value per lb. Calories	No. and Variety	Energy value per lb. Calories
1. Ganter	1194	15. Seedling No. 1	1282
2. Harman	923	16. Seedling No. 2	812
3. Miller	1107	17. Seedling No. 3	1132
4. Walker	952	18. Seedling No. 4	1019
5. Sharpless	741	19. Seedling No. 5	846
6. Chappelow	1325	20. Seedling No. 6	948
7. Blake	1147	21. Harman	852
8. Chappelow	867	22. White	722
9. Carton	.....	23. Fowler	987
10. Carton	949	24. Northrop	.....
11. Unnamed	1115	25. Cardinals	597
12. Topa Topa	778	26. Northrup	1101
13. Mattern	1240	27. Trapp	599
14. Northrup	1303	28. Azusa	1042

DIGESTIBILITY

There have been no metabolism experiments carried on in connection with the avocado, yet it is only fair to assume that this fruit is as easily digested as many others whose coefficients have been determined. Such data clearly prove that the fruits are quite thoroughly digested. While the availability of the protein rates below, the digestion coefficients of the carbohydrates compare favorably with, and those of the oils and mineral matter are fully equal to those obtained for the mixed diet.

DIETETIC VALUE

The dietetic value of fruit, aside from the actual nutrients which it contains, lies in its succulency—its minerals and organic acids. If gauged by its nutritive value alone, fruit would seem to be an expensive form of nourishment, but when its hygienic qualities are considered its money value to the consumer is difficult to estimate. Some fruits carry more nourishment with their hygienic properties than others. Some contain minerals which are more valuable to the system or less commonly distributed than others. Therefore, while there are general properties which are common to all fruits, each has special properties which justify individual consideration.

While the special dietetic value of a food can not always be forecast by the chemical analysis, it is certainly permissible to suggest the possibilities which are indicated through such investigation. It is always necessary that such theory be confirmed by clinical experience.

Judging from its composition, the avocado should perhaps prove to have laxative qualities of a peculiar or individual type, possessing as it does the combination of the usual "fruit principles," and that of fat or oil. The laxative properties of most fruits depend upon the stimulating effects of the fiber upon the wall of the intestine and partly upon the organic acids and minerals. Oil has a tendency to soothe and to lubricate the intestine even while it acts as a mild laxative. The avocado is a natural combination of these two types of foods—as if fruit and olive oil had been chemically combined by nature. Whether or not there is any special advantage in this natural combination over that made by a proper selection of foods remains to be proved. There are no clinical data on the subject, but future experimental work may give some interesting results.

The fact that the native Cubans prefer this fruit to any other of their abundant supply may be due to its flavor alone, but it is more than likely that the preference is more deep seated, and that it is the result of generations of experience or of a knowledge of its beneficial effects.